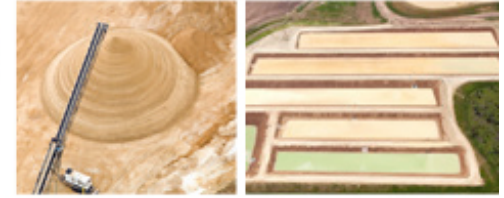


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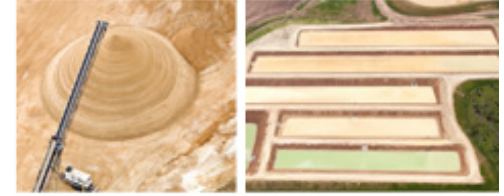
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**Vasili Nicoletopoulos, Founder,
Natural Resources GP, Greece**

Europe: A burgeoning market for fracking

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...How far is Europe from widespread fracking?...

Introduction

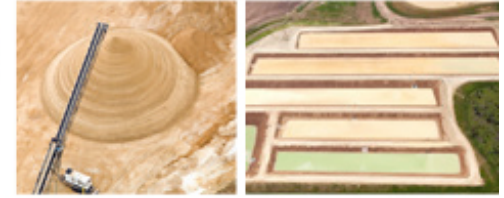
In the sphere of energy policies, sometimes revolutions happen and shake policies, scenarios and prospects and force them to react and adapt. The recent 'big one' is unconventional gas and oil.

This revolution impacted the energy sphere in general, by introducing a new pattern in the way this industry works, i.e. low cost gas, energy independency

Can this happen in Europe?

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Contents

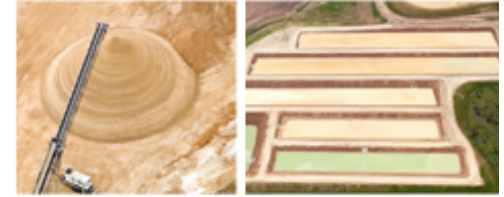
How far away is Europe from the widespread use of fracking technologies?

Would Europe have sufficient supplies of frac sands & proppants or would they import them?

- Introduction
- EU developments
- Environmental issues
- Public acceptance
- EU legislation, taxation, public policies
- Developments in EU neighbors
- Geopolitics
- Proppants
- Final comments

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Developments at Union level

EU rebalancing climate/energy policy, adding competitiveness & security of supply. EU industry policy addresses weaknesses of EU competitiveness vs US & China

June '13: EIA: Continent's combined shale resources [w/o Russia]: 7th

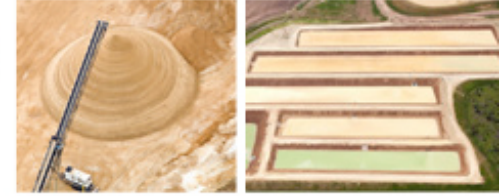
July '13: US & EU Free Trade Deal: Trans-Atlantic Free Trade Agreement, Trans-Atlantic Trade & Investment Partnership, impact on global energy
→ increased gas exports fm US to EU

Aug '13: EC to develop legal framework for SG exploration in Europe

Sept 12, '13: EP to include SG fracking EU Environmental Impact Assessment Directive update?: vote postponed to the Oct 1 session

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EU Developments by country...

Austria Nov '12: Lower Austria governor: 'Preclude drilling for SG w/ fracturing'

Belgium Feb '13: Federal Energy Secretary: 'Govt would adopt pragmatic position on SG'

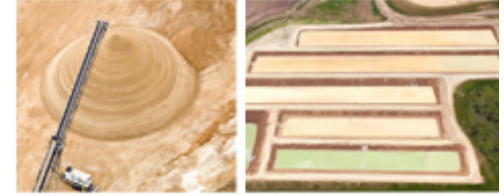
Bulgaria June '13: Environment Minister: 'Moratorium on SG drilling an impediment fm public mistrust of Bulgarian/EU laws, country's good environmental legislation could afford SG exploration'

Czech Republic July '13: SG exploration unlikely til beyond '14 due to govt & public concerns

Denmark May'13: Total exploring for deep SG in 2 license areas in the north, plans 6- yr exploration program

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...EU Developments by country...

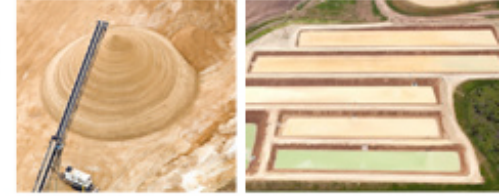
France June '13: Industrial Renewal Minister calls for SG debate – ‘potential benefits for economy’. Parliamentary Office for Evaluation of Scientific & Technological Choices endorses SG exploration. **July '13:** President Hollande again ruled out SG exploration w/ fracking ‘during his presidency’.

Germany Sept '13: Wintershall restarts SG endorsement: ‘positive consequences on economy’

Lithuania, Sept 16: Tender commission suggests govt grant SG exploration rights be given to Chevron: ‘legally, no other decision is possible’

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...EU Developments by country...

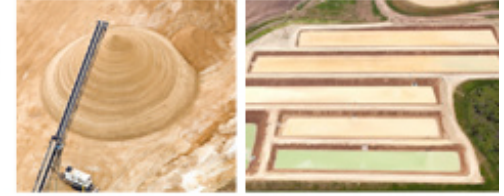
Netherlands June '13: Labour Party to vote against SG exploration. Cuadrilla, DSM, Queensland Gas SG/SO leases. **Aug '13:** Economics Minister strong supporter of future exploitation, releases safety assessment: 'gas is of great importance for the country, for energy supply, for the economy'. **Sept '13:** 12-18 mos nationwide study on all possible SG test drill locations, before a decision on the matter.

Poland Govt committed. **May '13:** ConocoPhillips, Marathon, Talisman shale test programs: limited success, modest gas flow rates. EBRD to shift focus to funding energy projects reducing country's reliance on coal; new strategy 2014-2016 incl. financing for unconventional gas-related projects

Romania May '13: PM Ponta allows SG exploration on Black Sea coast. **July '13:** 3rd in European reserves [ANRM]. **Aug '13:** Petrom to analyze opportunity to enter market > 2021

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...EU Developments by country

Spain May '13: San Leon Energy, BNK Petroleum hold leases, actively exploring Basque-Cantabrian Basin. **July '13:** Valle de Mena, Burgos, declares municipality “fracking free” citing absence of information/transparency by autonomous govt against exploitation/extraction in Great Enara

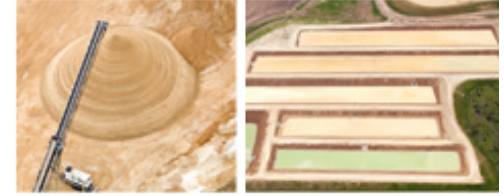
Sweden May '13: Numerous cos apply for exploration licenses, Shell most active; ‘They drilled 3 wells, but found it uneconomic’

UK May '13: SG reserves > 1/3 of annual gas needs. Govt supports SG -- Energy Minister promotes benefits to local communities near explorations.

Sept '13: Explorer IGas to start drilling exploratory well, to end in H1 '14, appraisal analysis to end Sept '14. **Sept 9, '13:** Cameron & his Energy Secretary pushing to expand SG exploration

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Environmental Issues

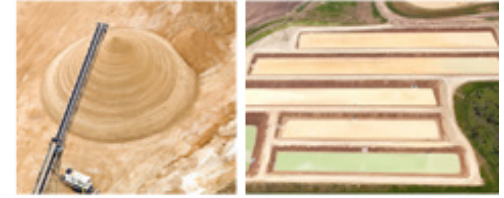
Lithuania Sept 16, '13 :strengthened environmental restrictions for using SG,SO technologies. Environment Ministry: 'New regulations, environmental impact study, public consultations before exploration can start'

UK Sept '13: Energy Secretary 'Gas, as the cleanest fossil fuel, is part of the answer to climate change, as a bridge in our transition to a green future, especially in our move away from coal'. Study estimates that C- footprint of UK-produced SG would likely be significantly < than coal or imported LNG.

Netherlands Aug '13: Witteveen + Bos, Arcadis+Fugro consortium report on potential SG risks, commissioned by Ministry of Economic Affairs: 'very small' risks despite 'accumulated risks being slightly larger' than conventional explorations -- due to greater number of wells required

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Public acceptance

Germany July '13: Geologists campaign for greater HF public acceptance.
Aug '13: newspapers, TV news & half a dozen radio stations

Romania Sept '13: > 3,500 people protest Chevron's SG drilling plan but
'>60% of people questioned in poll claim being poorly informed re unconv
resources –National Agency for Mineral Resources.

UK Aug '13: > 1,000 protestors in W.Sussex village drill site, opposing
Cuadrilla project. SG industry: planning permission & public support bigger
obstacles to SG exploration

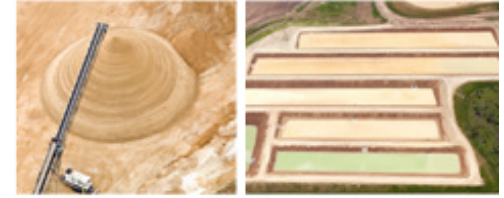
Bulgaria June '13: Opponents rallies in Sofia/Bucharest, marching &
gathering at border crossing and prospective SG regions

Poland Mar '13: pro-SG policies supported by > 70 pct of population

Sweden: interest groups, environmentalists, certain landowners, local
residents oppose HF

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EU Legislation. Taxation. Public Policies...

Aug '13: SG a divisive issue, highlighting growing tension between EU energy & climate policies

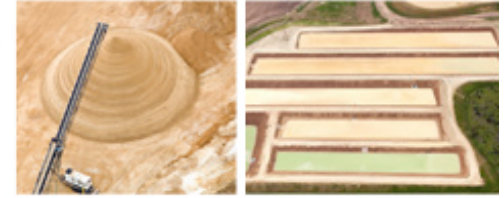
EP Sept 11, '13: Draft report proposes amending existing legislation to require environmental impact studies for non-conv HC exploration/extraction, measures to prevent conflicts of interest & ensure public is informed/consulted

EC July 16, '13: EC to draft rules proposal by end year, to settle 'some serious legislative gaps... don't talk about banning fracking at EU level, but ensure HF in a safe & secure way', EU Environment chief. **Sept 9, '13:** EC draft paper on shale expected Oct. Commission VP Tajani, 'Personally, I am in favor of SG in Europe because we have to do more for industry'.

Bulgaria June '13: Env't Minister: 'HF moratorium a temporary measure, no solution'.

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...EU Legislation. Taxation. Public Policies...

Czech Republic July '13: Govt to draft/implement new legislation to establish clear legal & technical framework

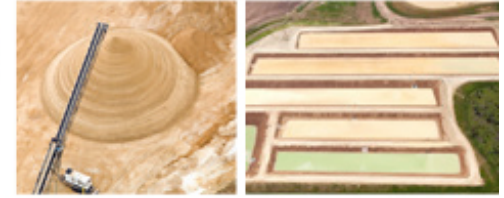
France June '13: Different opinions between ministries of environment & industry -- debate on govt policy likely to continue

Germany May '13: Draft legislation on how to allow shale devt, use of HF under environmental safeguards

Poland June '13: Govt: 1. proposal of controversial law on HC taxes, to come into force in 2015 w/ taxes not be collected until 2020; 2. National Mining Resources Operator would not have veto over license-holders' decisions. Parliament yet to approve either, lawmakers analyzing ways to make shale exploration more attractive for U.S. cos

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...EU Legislation. Taxation. Public Policies

Romania May '13: Lacks specific regulations for SG devt, thus shale applications under country's conventional petroleum terms

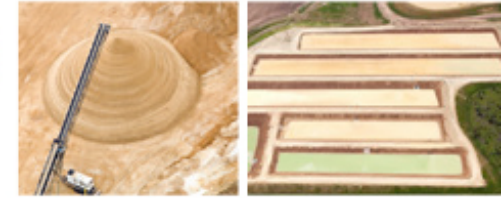
Spain July '13: Draft law by Industry Minister to add fracking to national HC law: all cos to use HF to submit envt'l impact studies. Agriculture Ministry seeks shortening time frame for envt'l impact.

UK July '13: Govt proposed to cut tax on portion of shale production to 30 pct & maintain time value of companies' losses for up to 10 yrs. Published guidance for local authorities' planning for onshore oil/gas to give SG industry transparency

Sept 19, '13: A British-Polish Shale Alliance in Europe?

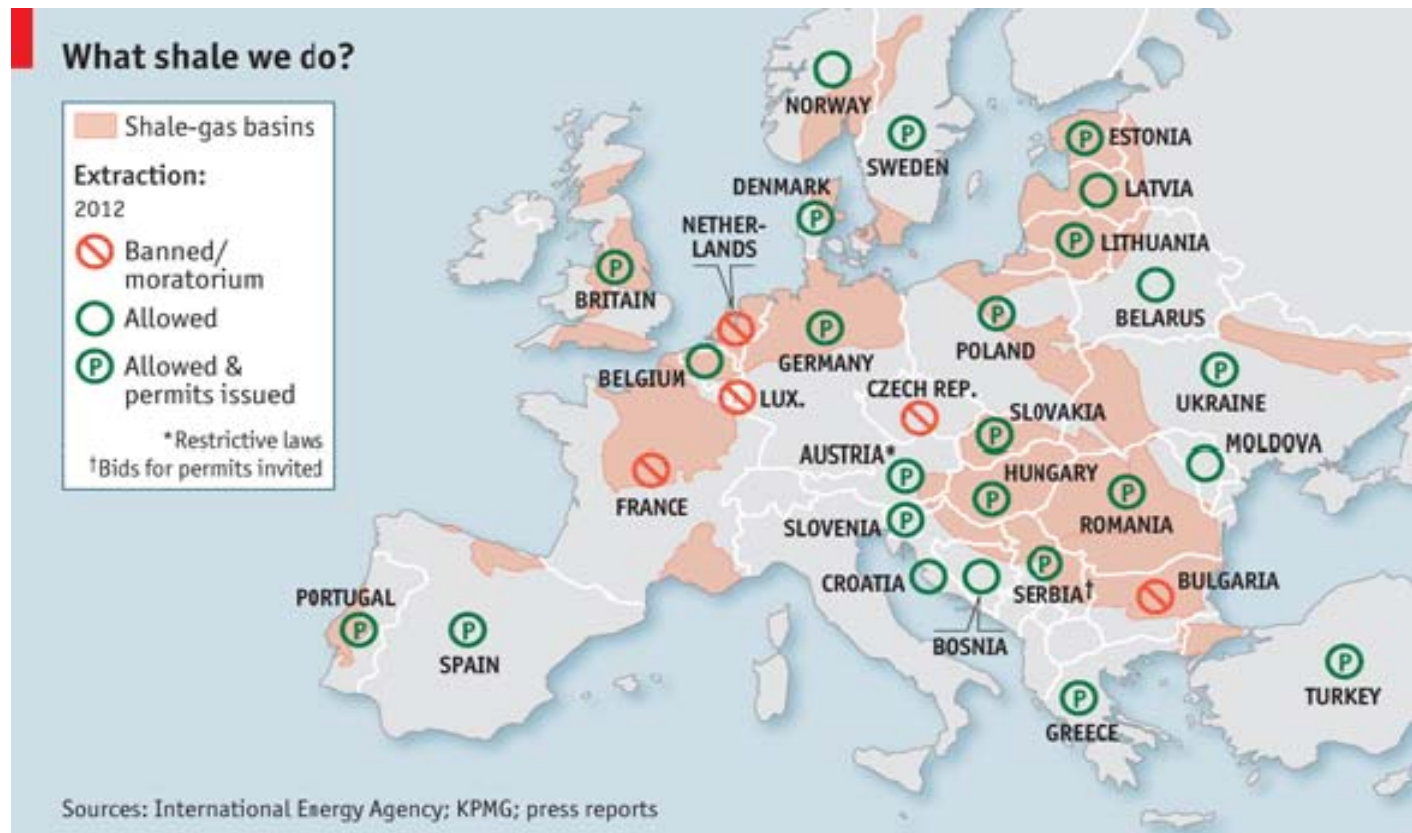
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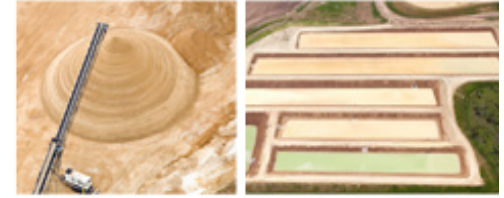
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Developments in EU neighbors

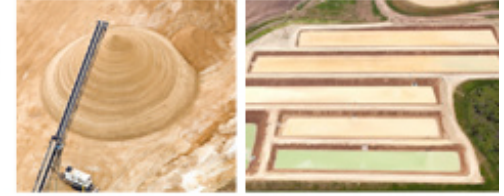
Ukraine Aug 30, '13: Ecology & Natural Resources Minister expects local authorities to approve SG exploitation/ production. **Sept 13, '13:** Shell agrees to explore Yuzivska block, w/ gas extraction starting '15. **Sept 19, '13** US ambassador Pyatt: the US will be actively cooperating w/ Ukrainian authorities in a bid to boost the nation's energy independence

Russia May '13: Russian oil cos interested in US unconv oil/gas techniques. Rosneft agrees w/ ExxonMobil/Statoil to begin drilling in 2013; Gazprom Neft & Shell to start drilling early '14. **Sept 2, '13:** tax breaks on production of hard-to-recover 'tight' oil. New regime: Russia to apply zero rate of mineral extraction tax. Bazhenov shale, Siberia.

Turkey July '13: 'Ready to produce SG': Evt & Urban Planning Minister

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Geopolitics

HF in the **U.S. gas industry** driving prices to a decade-low

EU shale drilling to ease dependence on **Russian** fuel, hurt Kremlin's ambition to secure a future as energy superpower

SG to enhance **energy security** within Europe, bring enormous economic benefits. Putin pushing investment in Russia's gas industry, planning new fields & pipeline to Asia.

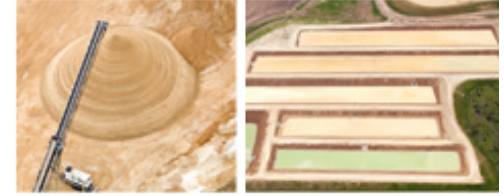
EU has to **rebalance** climate and energy **policy**, adding competitiveness & security of supply, to match the Chinese industrial might & the SG-driven revival of US manufacturing

Poland July '13: Govt, encouraged by firm popular support, looking to domestic SG/SO to reduce imports of Russian gas

Romania June 10, '13: SG 'can be a viable solution' for energy independence - Energy Minister.

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Would Europe have sufficient FS & proppants supplies or would they import them?...

The proppants [PRT] market

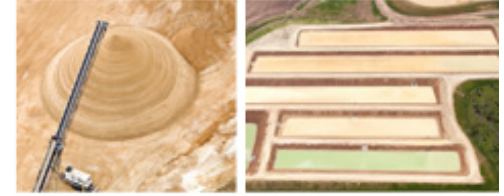
To serve increase in unconv gas/oil, adequate PRT qty must be supplied
Avg PRT consumption per horizontal well: up to 1,600mt in 1st drilling stage, ~ 600mt for well stimulation after 5–7 years. Different PRT begin to be manufactured in new consumption countries--> cost reduction.

In US/Canada, depressed NG price caused major shift in PRT destinations fm unconventional gas plays to unconventional oil plays

While N. American hydraulic fracturing market nearly reaching maturity [?], ROW market still in infancy

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...Would Europe have sufficient FS & proppants supplies or would they import them?...

The proppants market

US proppant use rose dramatically: 35 m s.tons today 80 FS, 10 coated, 10 ceramic...could reach 10 bi \$+ by '17 [IM, Sept 5, '13]

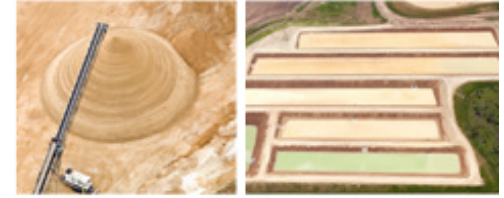
ROW PRT production ~ 20% of global, expected to grow @ 15.8% CAGR; players in low cost India/China to multiply, to export to N. America; HF poised to take off eg in Poland & China → PRT production to start catering to these new demand centers

June '13 PRT suppliers globally in last decade fm just a handful to >> 50 [J. of Petroleum Technology]; PRT market grew in volume 10X fm 3 bi lbs [1.4 mi mt] in 2000 to ~ €4.5 bi in 2012

Russia, Mexico, Australia, etc plus countries lacking oil/gas, eg Argentina, Poland to invest on SG: new PRT **consumption**. Russia & China could be two biggest new PRT consumption countries

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...Would Europe have sufficient FS & proppants supplies or would they import them?...

Ceramic proppants [CP]

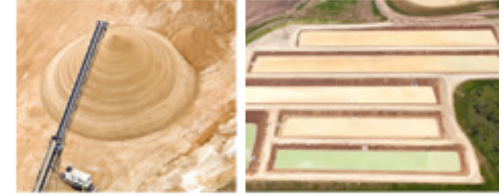
~2 mi mt/yr?

The view fm China *Source: Proppant producer Xinmi Wanli, May 23, '13*

- 'Chinese started capturing market, esp. in N. America, gradually paving own way in world, but w/ still long way to go. Market was excellent from H2 '10 through end '11. At the beginning only tens of Chinese proppant manufacturers, now hundreds.'
- 'Many cos entered market w/o rational planning. New factories built close to raw material mines w/ support fm local govts who only cared about political performance.'
- 'Bubble burst inadvertently in '12. US mkt fell fm peak, CP use plummeted'

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FS

Sibelco, Belgium; Saint Gobain, France; Others: major sand producers

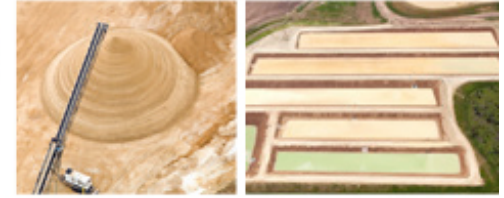
CP

Imerys, France; Baltic Ceramics, Poland: into production 2014; S&B Industrial Minerals, Greece: bauxite; Kaolin AD, Bulgaria; Borovichi & Fores, Russia; Castata, UK

Polish Institute of Ceramics & Building Materials entered competition 'Polish Invention of the Year 2013', organised by Min of Science & Higher Education w/ Polish National Television; subject: 'Ceramic backfilling materials for use in SG'

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...Would Europe have sufficient FS & proppants supplies or would they import them?...

Source: Clive Mitchell, BGS UK, IM Conference, Apr 30, '13

UK silica sand resources

UK ~ self-sufficient in Si sand
40 quarries produce 4Mt Si sand
Sandstone e.g. Carboniferous Passage, central Scotland
Glacial e.g. Pleistocene Chelford Sand, Cheshire
Near shore marine/ coastal e.g. Lower Cretaceous Sandringham, Leziate, Norfolk
Alluvial [river], lacustrine [lake], aeolian [wind blown]

UK frac sand resources?

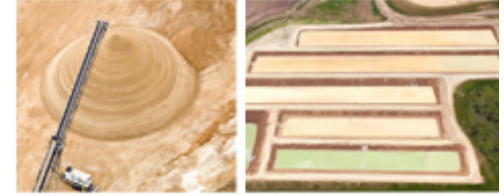
20 foundry sand quarries

Main sources

Sandringham, Norfolk
Woburn, Bedfordshire
Folkestone, Surrey & Kent
Chelford & Congleton, Cheshire
Wind, N. Lincolnshire

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Final comments

In the US

SG a revolution...but also a victim of its own success?...as gas price and productivity falls might render SG production uneconomical?

In Europe

Important unconventional oil/gas resources. Proppants?

Excellent industrial culture

Need to diversify energy sources

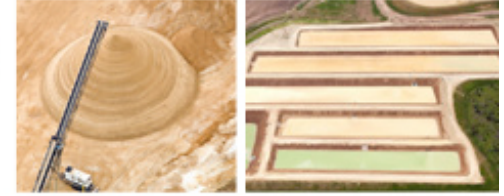
Regulatory, technological & infrastructure issues to be addressed... bigger delays & costs

An interim/parallel solution for Europe could be to *import* gas fm US

Cooperation, rather than conflict: incentives to neighbors, 'agricultural deal elevates Wyoming FS supplier', etc

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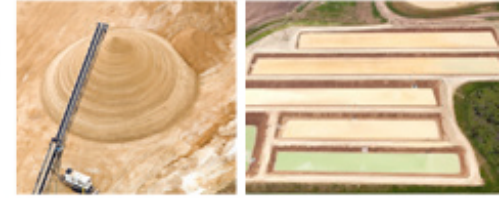
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Selected References

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- Fracking in Europe: the potential and the pitfalls, V.Nicoletopoulos, Industrial Minerals, November 2012
- Fracking in China: Future Challenges Ahead, V.Nicoletopoulos, Industrial Minerals, April 2013
- Unconventional Oil and Gas: Can the US model be applied in North Africa? V.Nicoletopoulos, 3rd Tunisia Oil & Gas Summit, Hammamet, Tunisia, September 2013

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Thank you

**and see you again at 'The South-Eastern European
Conference on Shale Oil and Gas', Athens, 2014**

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